



# **RHIC Polarization Transmission, issues**

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# RHIC Polarization Setup

- 2 Siberian Snakes per ring hold the spin tune  $\frac{1}{2}$  all the way up during the acceleration
- The vertical tune was chosen at 0.23, between 2 high-order spin resonances:
  - $1/4=0.25$  ; depends on vertical orbit
  - $3/14=0.2143$ ; exists even without orbit errors
- The special vertical orbit, "really" flat was used as the ideal orbit
  - Made from measured misalignment data (3 years old).
  - The goal number for vertical orbit correction was 0.5mm rms
  - No measured orbit data in defocusing quads

## The vertical tune was put between two higher order spin resonances

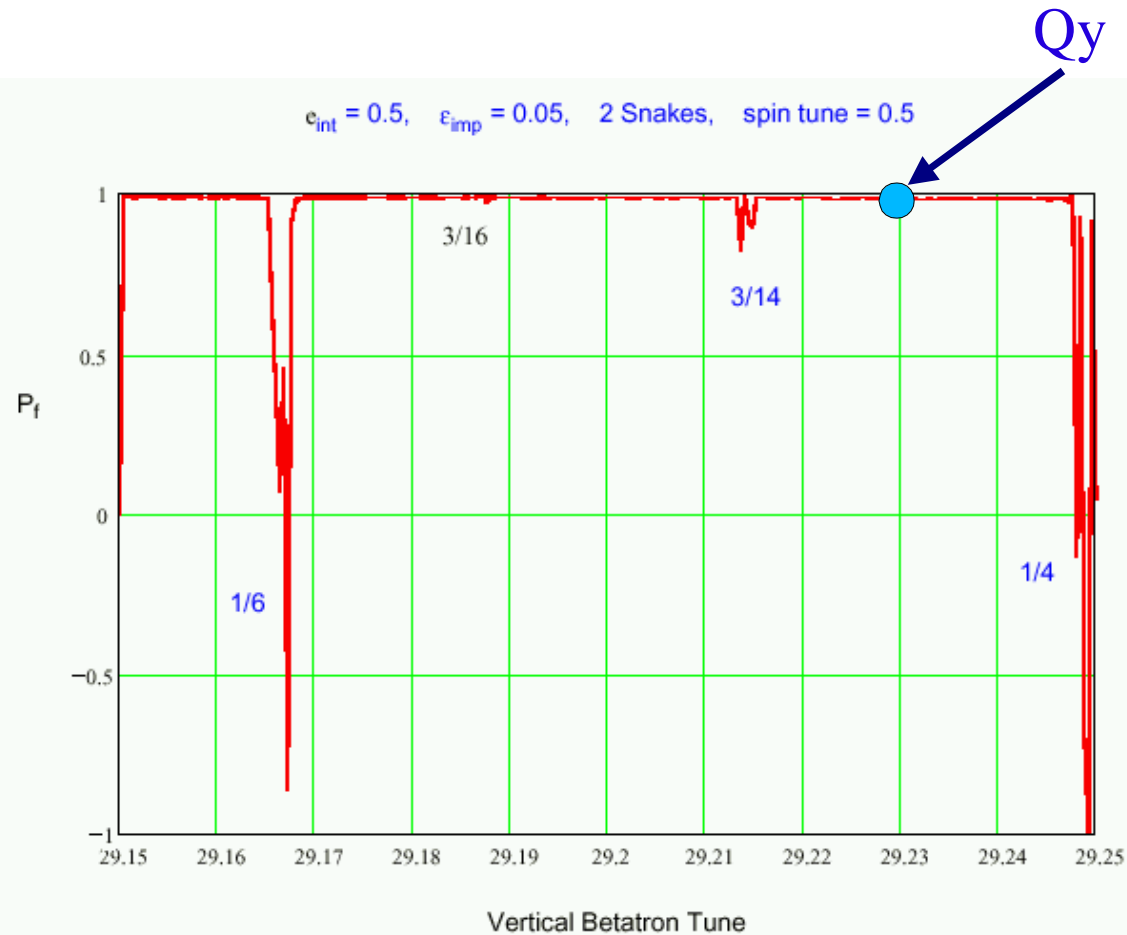
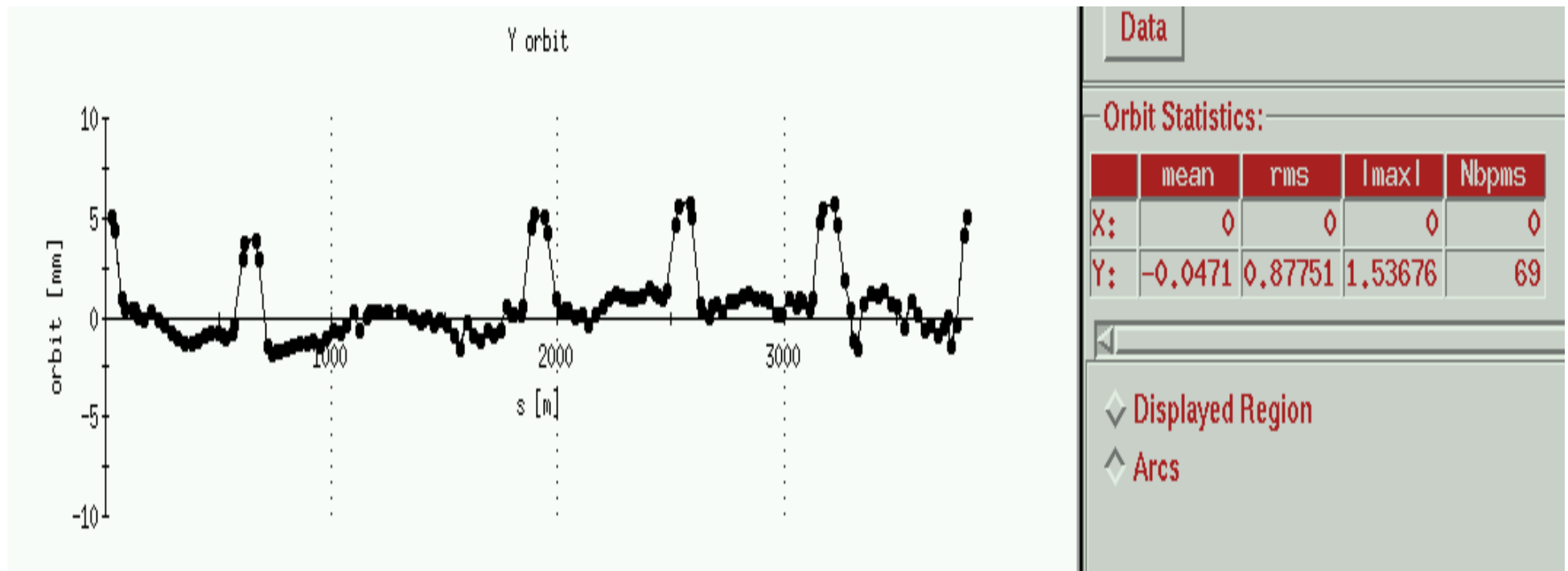


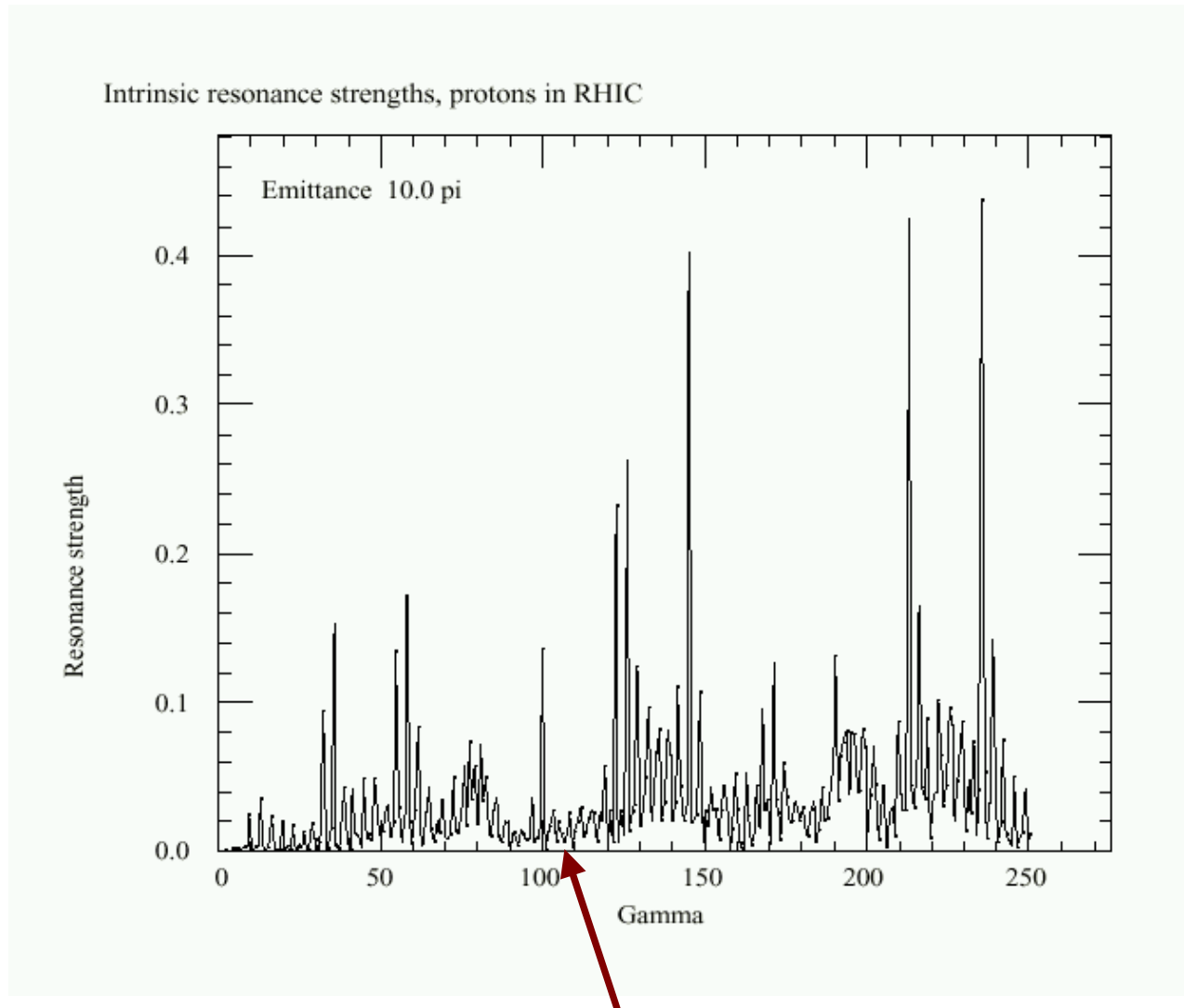
Figure 5.3: Vertical component of the polarization after acceleration through a strong intrinsic resonance and a moderate imperfection resonance shown as a function of the vertical betatron tune.

## Ideal Blue orbit for polarized protons (with vertical separation bumps included)



# Polarization preservation

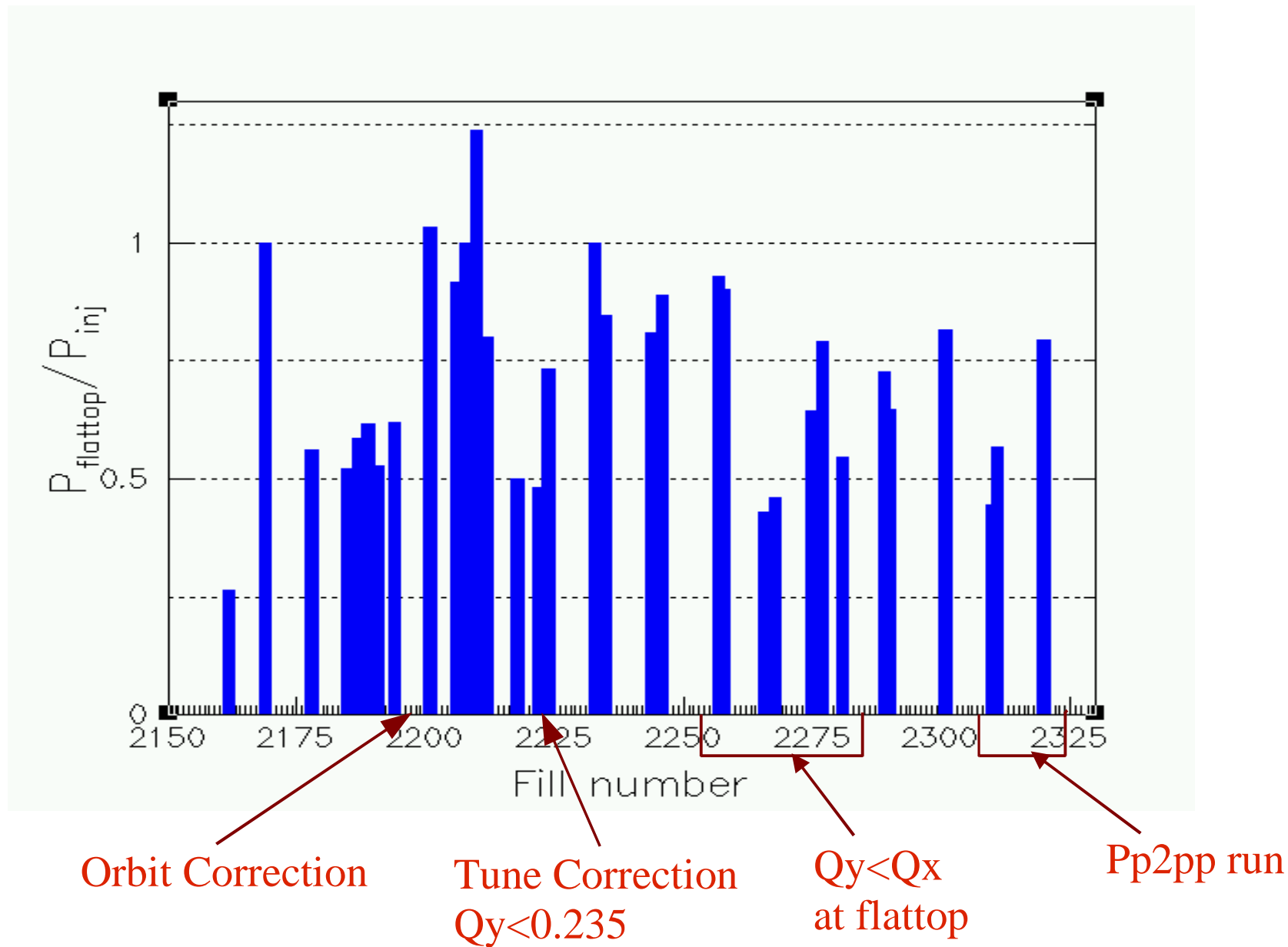
- The intrinsic resonances: 4 dangerous zones on the ramp
  - Special attention to the tunes and orbits at these zones
- Yellow polarization transmission was good the most of time
- Blue polarization transmission required more attention and periodical corrections
  - Mostly tune corrections



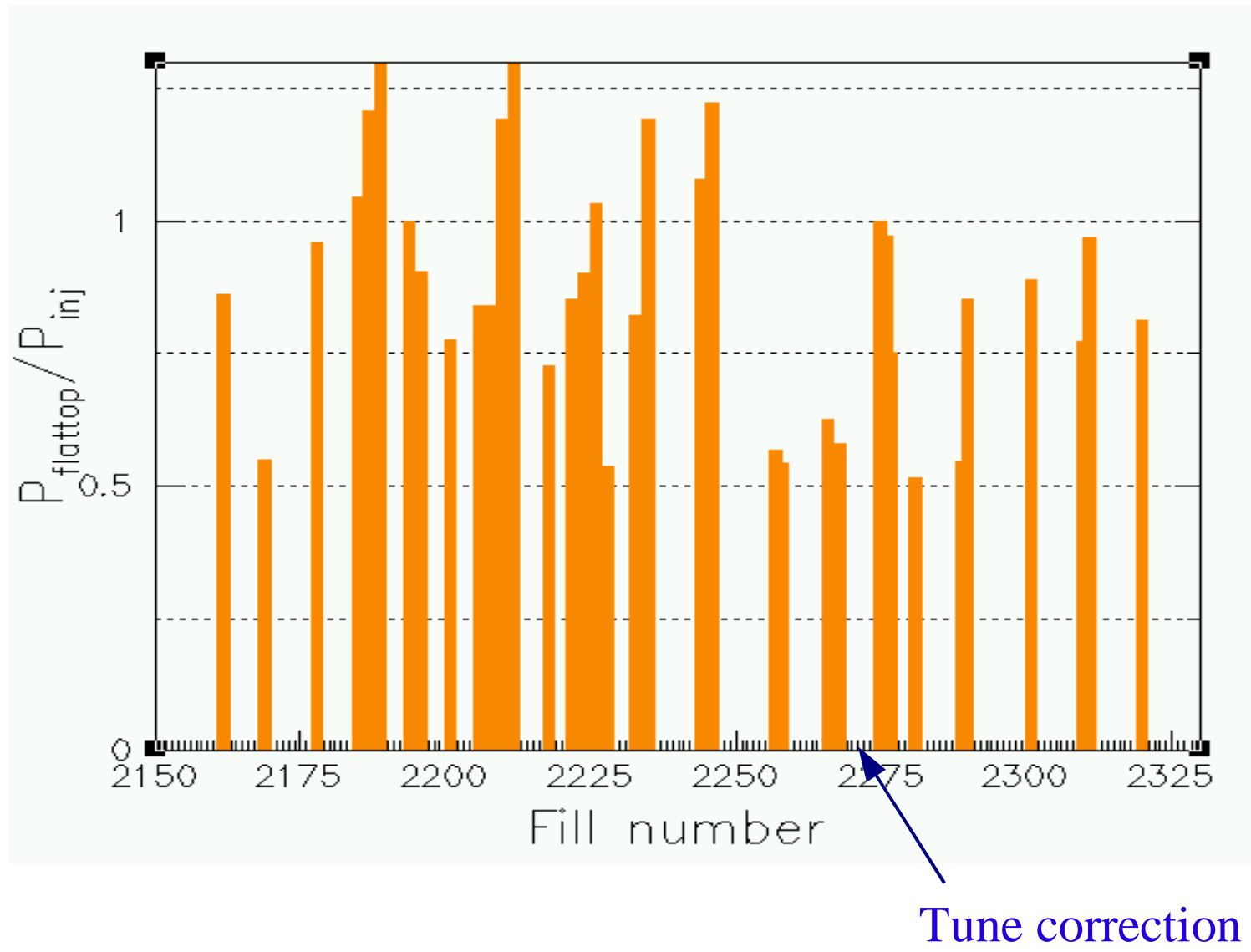
The flattop energy this run

Note that the emittance was more than 2 times larger this run with the resonance strength increasing as the square root of the vertical emittance

# Blue polarization transmission on the ramps



# Yellow polarization transmission on the ramps





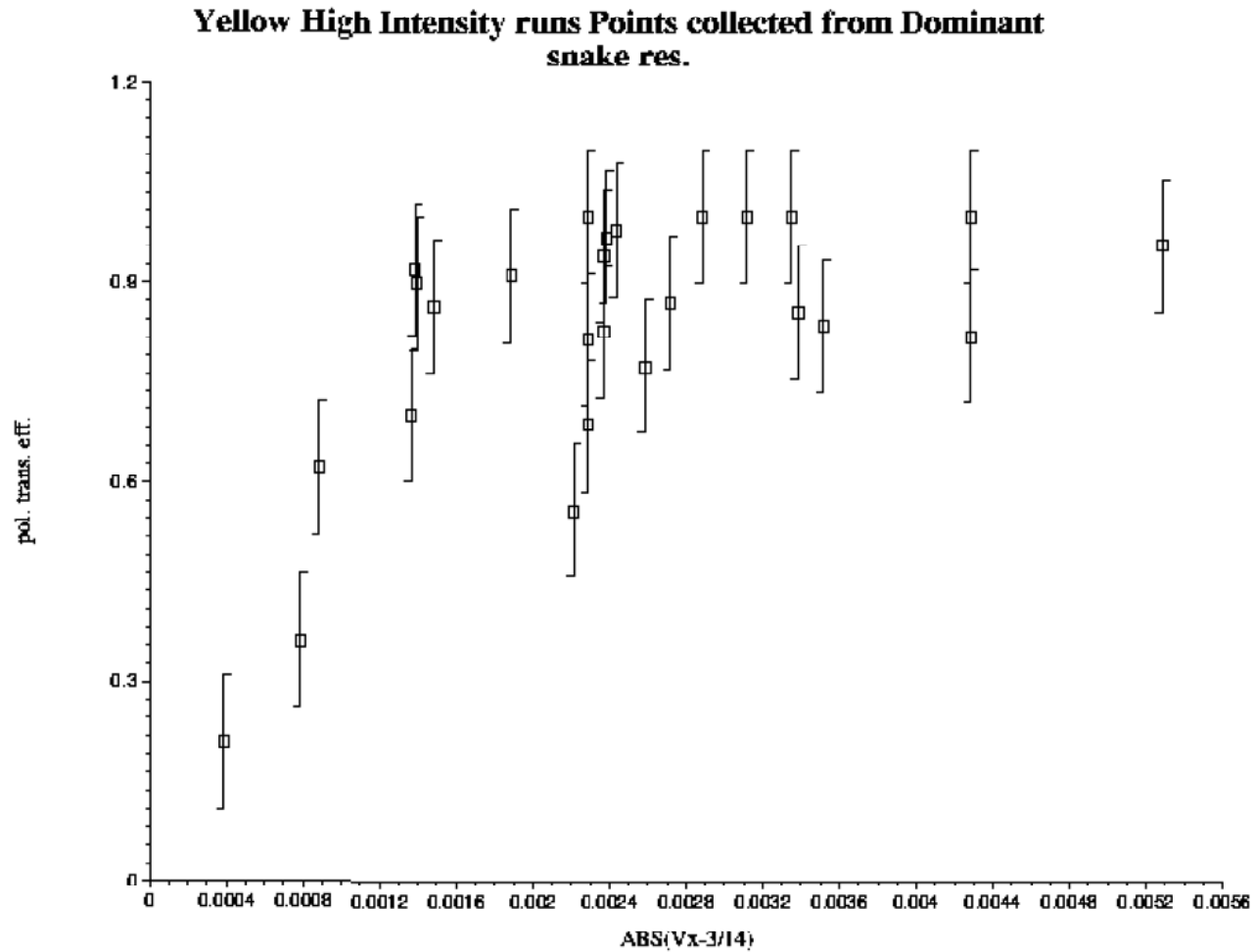
# The empirical rules for the ramp:

- Keep the vertical tune below 0.235
  - Total polarization loss when  $Q_y$  exceeded 0.245 at the end of the ramp was observed
- Horizontal tune + coupling might be important too
- Keep the orbit rms below 1mm
  - Blue depolarization was observed with the horiz.orbit rms higher than 1.5 mm
- The polarization deterioration at the store was observed when the vertical and horizontal tunes were switched in Yellow.
  - $Q_y$  close to 3/14 resonance

# The Polarization Analysis

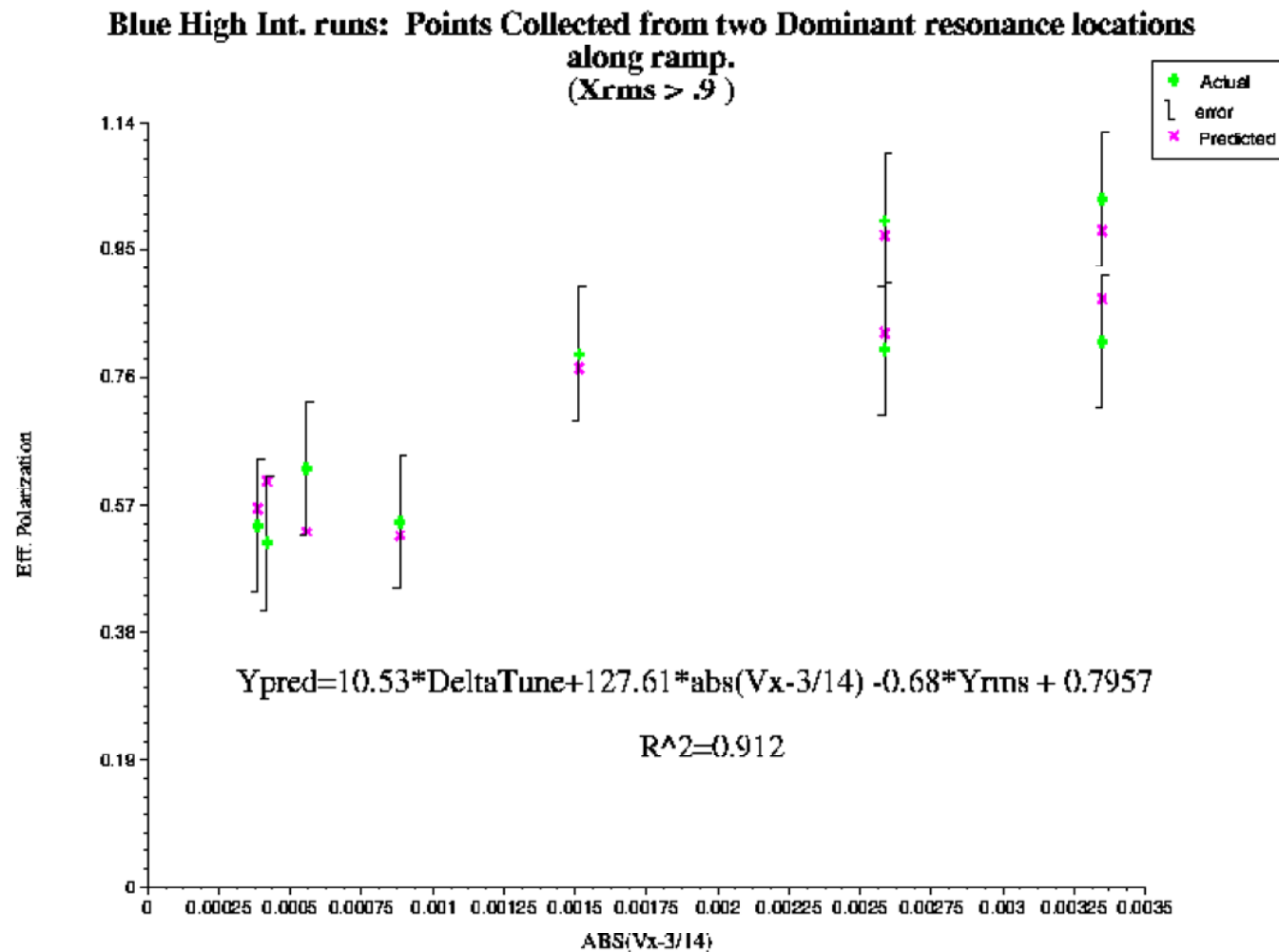
- The search for correlations between the polarization and tunes, orbits, coupling, emmittances is underway
  - The horiz. tune should be kept away from  $3/14$  (V.Ranjbar)
  - Was Blue worse than Yellow because of different emmittances? Or the goal orbits?
  - The Blue orbit more critical than Yellow
- The spin (SPINK) tracking to reproduce observed depolarizing effects and to study them (A.Luccio)

# The run data shows depolarisation by 3/14 resonance caused by coupling in Yellow

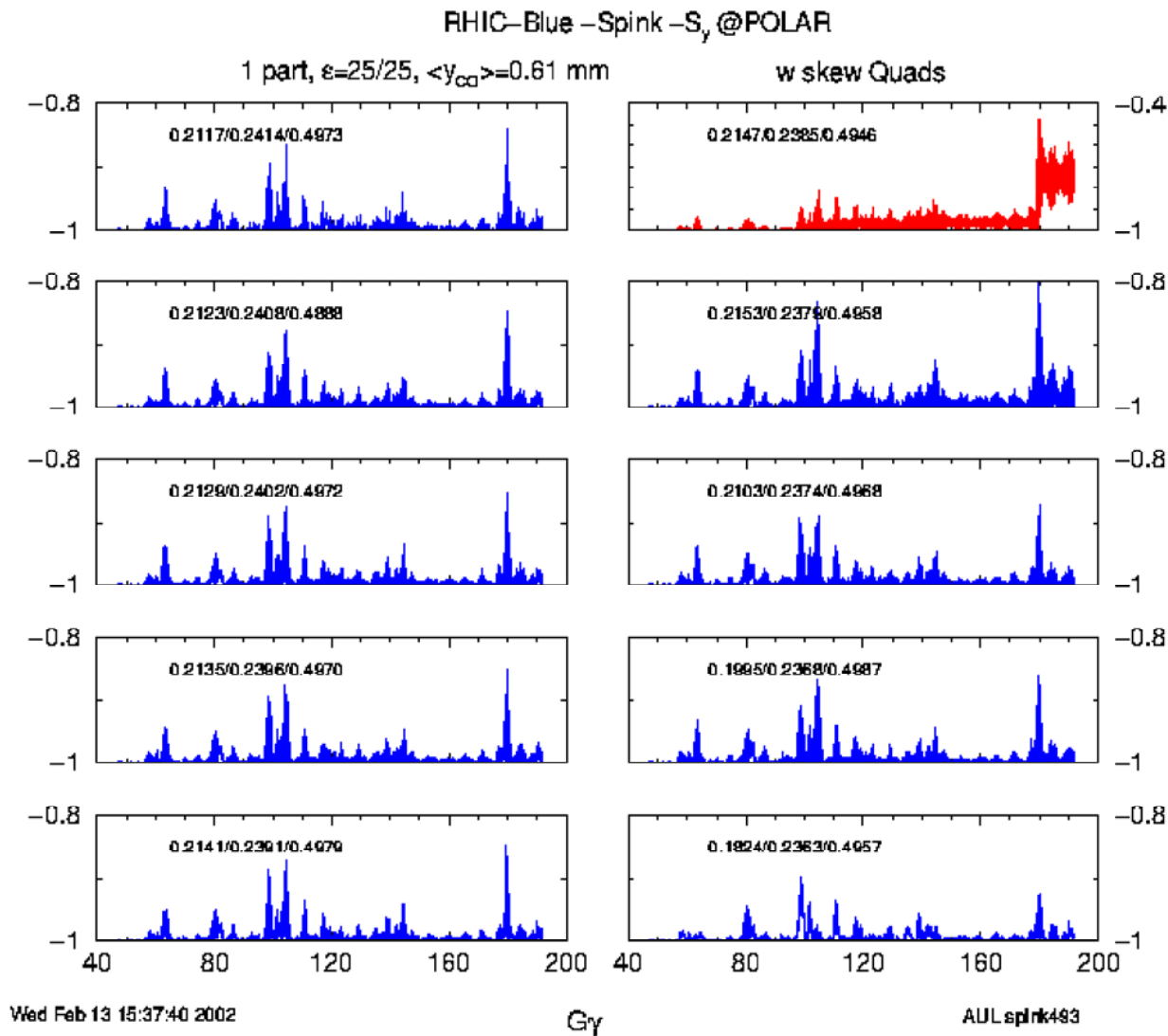


## Blue data for the 3/14 resonance

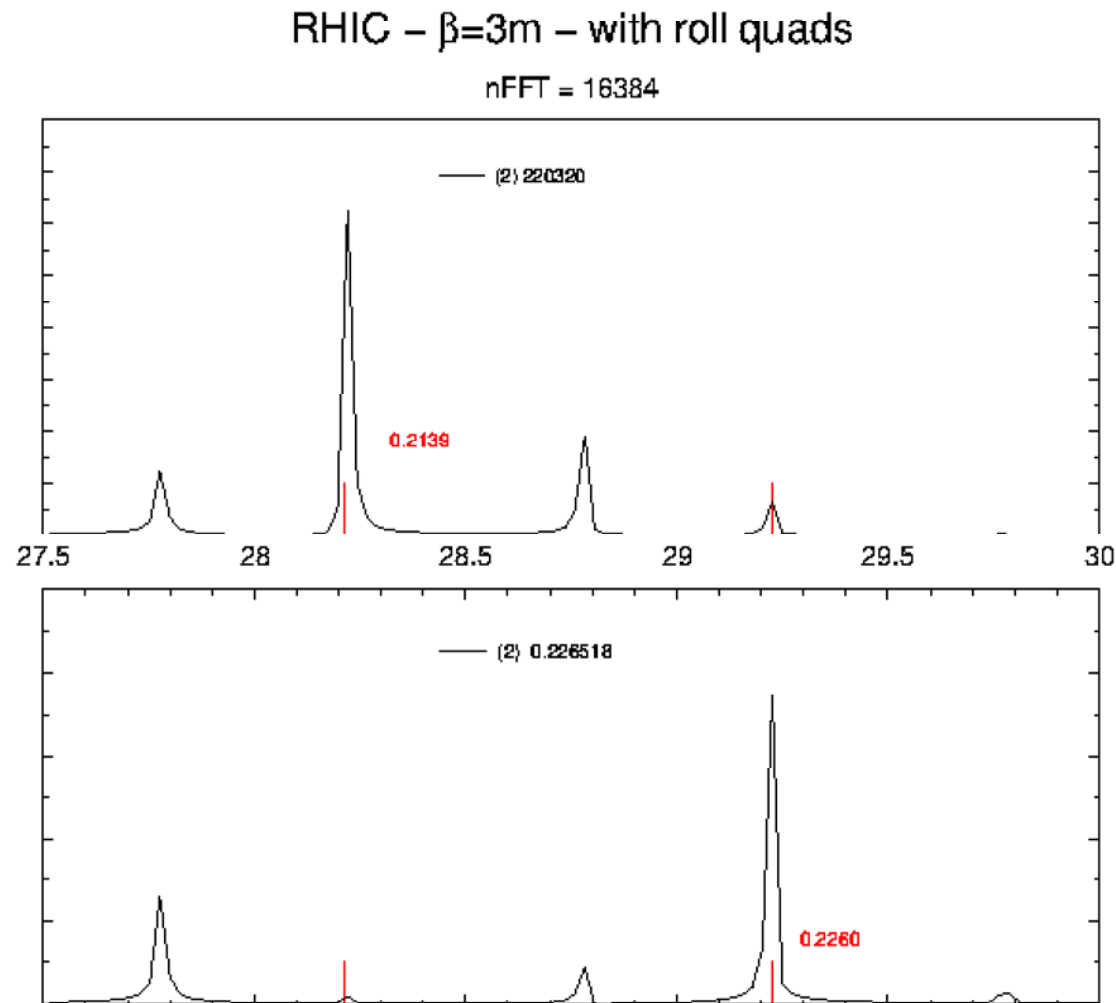
The resonance was not so pronounced as in Yellow



# SPINK modeling of 3/14 resonance in the presence of betatron coupling



# Betatron tunes calculation from SPINK



# Next Run

- Higher energy→ stronger resonances
- The goal orbit needs to be revisited
  - Newly measured misalignment data
  - Analysis of the corrector strengths
  - Coupling and dynamic aperture from the ideal orbit going off center in quads and sextupoles.
- Better beam control on the ramp would be necessary
  - Tune feedback
  - Improved orbit correction ( below 0.4mm rms)
  - Coupling control on the ramps